

NASA TECH BRIEF

Lewis Research Center



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

Equipment and Procedure for Determining the Elastic Modulus of Carbon-Epoxy Composites

A new method of measuring the elastic modulus of carbon/epoxy filament-wound structures includes the test device design and fabrication and a standard "NOL ring" (Naval Ordnance Laboratory test ring,

epoxy rings. The NOL ring, already being used in tensile strength determinations, eliminates the requirement for an extra test specimen for determining the elastic modulus.

The testing device is shown in the photograph. Equal and opposite line loads are applied to the ring by 113 g (0.25 lb) weights. Deformation along the load axis is measured with a $2.54 \mu\text{m}$ (10^{-4} in.) dial indicator mounted such that it applies virtually no load to the ring (less than 1 gram). Contact between the indicator and the ring is detected with a very sensitive microswitch which operates a light. The stem of the indicator is adjusted manually until the light flickers. Deformation values are repeatable to within $\pm 5.08 \mu\text{m}$ (0.0002 in.).

The equation governing the elastic modulus is:

$$E = k \frac{12 \cdot 0.149r^3}{wt^3} \left(\frac{p}{\Delta} \right)$$

where

r = mid-surface radius

w = ring width

t = ring thickness

$\frac{p}{\Delta}$ = slope of load-deformation plot

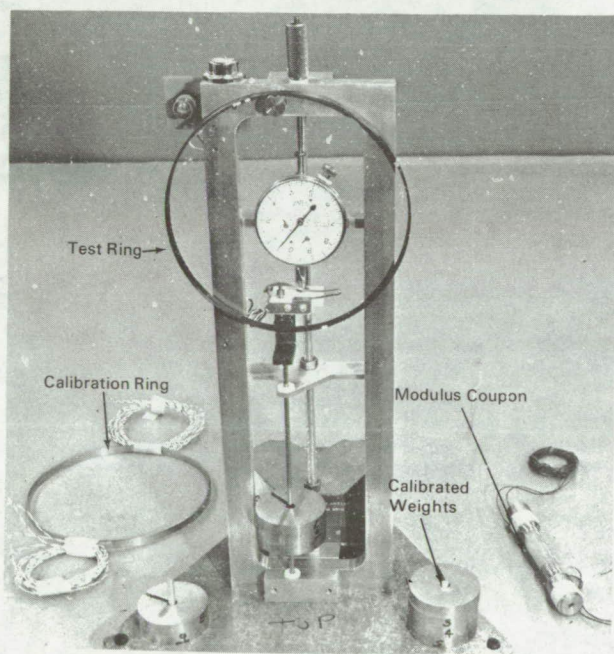
k = calibration factor

Before each use, the testing device must be calibrated with a steel calibrating ring of known modulus.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B71-10397



ASTM designation D-2290-64T) as the test specimen.

Previously, elastic modulus determinations were made by loading a ring in a testing machine, independently measuring the head movement of the machine and the load versus time, and then referring to a graph of head movement versus load to determine the modulus. The new method provides a more accurate measurement of the NOL ring elastic modulus, and is adaptable for use with fiberglass/

(continued overleaf)

Patent status:

No patent action is contemplated by NASA.

Source: A. Feldman, W. L. Brown, D. A. Stang,
and F. A. Penning of
Martin Marietta Corp.
under contract to
Lewis Research Center
(LEW-11116)